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CONTRACTOR: TURNBULL ENGINEERS INC.

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LICENSING ASSESSMENT

OF

MINERAL SCIENCES LABORATORIES

TECHNOLOGIES

for

C A N M E T

Energy Mines and Resources Canada

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Table of Contents

	SUMMARY	2
I.	INTRODUCTION	6
II.	LIST OF TECHNOLOGIES EXAMINED	7
III.	DETAILED REVIEW	10
	A. PATENTS	11
	B. PATENT APPLICATIONS	19
	C. BUSINESS OPPORTUNITY DOCUMENTS	31
IV.	CONCLUSIONS AND RECOMMENDATIONS	39
V	ACTION PLAN	44

SUMMARY

A total of 28 technologies was submitted to Turnbull Engineers Inc. for assessment as to marketability and licensing potential. These technologies, which included eight patents, twelve patent applications and eight business opportunity documents, demonstrated the wide range of activities of the Mineral Sciences Laboratories of CANMET.

The original methodology was to do a rough sort of the technologies and select two to four of the most promising for an in-depth assessment. However, it became apparent while examining the files that not enough information was available to do a meaningful evaluation of most of the technologies. In those cases where enough data were available, CANMET personnel had already progressed beyond the assessment stage. Thus, it was agreed that TEI would review all 28 technologies as to whether they should be pursued and give recommendations for further action.

It has been concluded that 16 technologies should be pursued, eight dropped and two may have promise, depending on the outcome of the suggested work. A summary of the recommendations for each technology is shown in the following pages. An action plan also is included.

The savings that would result from not maintaining (or prosecuting) the patents and patent applications that are recommended to be dropped should be investigated.

SUMMARY OF TECHNOLOGY REVIEWS

	Technology	Pursue or Not	Immediate Action	By Whom
Patents:				
1	Pressure Leach of U in Cl	No - Unless radium in residues is a problem.	Check Saskatchewan autoclaves - O.K. for Cl?	MSL
2	High Pressure Fluid Jet	No	--	X
3	Solid State As Probe	No	--	X
4	Fe Cl_3 Leach of MeS	Yes - As part of Cl Metallurgy Pilot Plant. NOVAGOLD has exercised their option.	MSL to develop marketing strategy.	MSL
5	Cu Recovery from NH_4 Solutions	No	--	X
6	Analyzer for Sulphur Forms	Maybe Suggest cooperative development program with LECO.	LECO not interested, so inventor will pursue on his own.	X
7	Assembly for TGA/DTA	Maybe Talk to equipment suppliers such as Dupont.	Approach Dupont.	MSL
8	PM's by S/Ex and H_2 Precipitation	No - Discuss INRAD's position with them.	Rough Cap./Op. Cost Comparison needed but data from existing producers not available.	X

	Technology	Pursue or Not	Immediate Action	By Whom
Patent Applications:				
1	Biodegradation of Glycols	Yes - Develop marketing strategy after patent issues.	Cost/benefit analysis, marketing strategy to be done. Jurisdictional problems to be solved.	MSL
2	Au Recovery by H_2 Reduction	Yes - Simpler and less toxic process yields high purity Au.	Determine long-term toxicity of thiourea.	MSL
3	T/C for High Temperatures	Yes - More extensive lab. testing needed, then develop strategy.	Continue lab. testing under co-op program with T/C vendors.	MSL
4	Alkali Sensor	Yes - Suggest cooperative test program with lab. equipment supplier.	Nothing until P. A. filed, then marketing strategy to be developed.	MSL
5	Filter Aid	Yes - Suggest cooperative test program with equipment manufacturer.	Formulate marketing strategy and pursue co-op testing program.	MSL
6	Hydrometallurgical Ag Refining	No - But determine MLSP position.	Cancel P. A.	MSL
7	Microwave Reactivation of C	Yes - Capital cost appears attractive.	Cost advantages need to be confirmed.	MSL
8	Bioabsorption Composition	Yes - More exploratory lab. work needed.	Lab testing to extend usefulness.	MSL
9	Reynolds Bubble Measurer	Yes - Need to determine market potential.	Approach Brinkman.	TEI
10	Recovery of Au using NaBH	No - Patent should be issued shortly.	--	X
11	Recovery of PGM using NaBH	No - Monetary advantage over present processes needed but data from existing producers not available.	--	X
12	Microwave Reduction of Foam	Yes - Although limited scope of U.S. coverage limits market, market could be developed.	Approach mineral equipment manufacturers.	X

Technology	Pursue or Not	Immediate Action	By Whom
Business Opportunity Documents:			
1 Supplementary Cementing Materials	Yes - Develop comprehensive marketing strategy to maximize return.	--	MSL
2 Biorecovery of Selenium	Yes - Overall strategy review required.	Cap./Op. cost comparison, seek Canadian client.	MSL
3 Hyceram	Yes - Identify possible licensors in the several market areas.	Develop marketing strategy.	MSL
4 Microwave Reactivation of C	Yes - See PA-7 above.	Develop plan.	TEI
5 Productive Use of Zn Residue	Yes - Overall strategy review required.	--	MSL
6 Biodegradation of Airport Runoff	Yes - See PA-1 above.	Review economics, develop Business Plan and marketing strategy.	MSL/TEI
7 Image Analysis System	Yes - Economics of system need to be reviewed.	Continue talks with Outokumpu.	MSL
8 Froth Analyzer	Yes - Could have wide application.		

I. INTRODUCTION

The technology assessments contained in this report were carried out under DSS Contract No. 23440-1-9115/01-SQ dated November 1, 1991 (Revised Work Program). A total of eight patents, twelve patent applications and eight Business Opportunity Documents were reviewed, both in Vancouver and in Ottawa. Each technology was examined for uniqueness, applicability (market size), technology development level, patent/patent application position, advantages/disadvantages over present methods, industry interest, potential licenses, conclusion as to possible marketability and licensing potential and recommendations for future action.

II. LIST OF TECHNOLOGIES EXAMINED

A. Patents:

1. Pressure Leaching of Uranium Ores in a Chloride Media
   Demopoulos/Ritcey
   File No. 7826

2. Percussive Tool with High Pressure Fluid Jet
   James/Dorscht
   File 8578

3. Solid State Arsenic Probe for Use in Pyrometallurgical Processes
   File 8647 Skeaff

4. Ferric Chloride Leads of a Metal-Sulphide Bearing Material
   File No. 8776 Lucas/Shima

5. Copper Recovery from Ammoniacal Solutions Using Extraction Mixtures Deschenes/Ritcey
   File No. 7535

6. Method for Analyzing Different Sulphur Forms
   File Nos. 8098, 8604 Moon

7. Assembly for Concurrent Thermogravimetry and Differential Thermal Analysis Mikhail
   File No. 8474

8. Direct Recovery of Precious Metals by Solvent Extraction and Selective Removal
   File No. 8062 Demopoulos/Pouskouleli/Prud'Homme

B. Patent Applications

1. Biodegradation of Alkylene Glycols Utilizing Selected Bacteria — McCready
   File Identifier - McCready - 5
   (Note: Same as Business Opportunity Document No. 6)

2. Recovery of Gold from Leach Solutions using Pressure Reduction
   File: Deschenes - 1 — Deschenes/Ritcey

3. Long Lasting Thermocouple for High Temperature Measurements of Liquid Metals, Mattes and Slags
   File: Dubreuil - 1 — Dubreuil/Skeaff

4. Long Lasting Alkali and Alkaline Earth Metal Sensor
   File: Dubreuil - 3 — Dubreuil

5. Filtration of Fine Solids using Hot Steam or Gas and Filter-aid Vapour — Stefanski
   File: Stefanski - 1

6. Hydrometallurgical Silver Refining — Tan/Dinardo
   File: Tan - 3

7. Microwave Regeneration of Activated Carbon — Haque
   File: Haque - 4
   (Note: Same as Business Opportunity Document No. 4)

8. Bioabsorption Composition: Process for Production and Process for Uses — McCready, et al
   File: McCready - 3

9. Reynolds Bubble Measurement Cell — Reynolds
   File: Reynolds - 1

10. Recovery of Gold from Thiourea, Thiocyanate or Thiosulphate Solutions by Reduction - Precipitation with a Stabilized Form of Sodium Borohydride — Awadalla/Ritcey
    File: Awadalla - 1

11. Recovery of Platinum Group Metals from Acidic Solutions by Reduction - Precipitation with Sodium Borohydride — Awadalla/Molnar/Ritcey
    File: Awadalla - 2

12. Use of Microwave Radiation to Eliminate Foam in Ore Leaching — Kondos, et al
    File: Kondos - 2

C. Business Opportunity Documents

1. Supplementary Cementing Materials

2. Biological Recovery of Selenium

3. Hyceram

4. Microwave Regeneration of Activated Charcoal
   (Same as Patent Application No. 7)

5. Productive Use of Zinc Residues

6. Biodegradation of Toxic Substances in Airport Runoff
   (Same as Patent Application No. 1)

7. Image Analysis System

8. Froth Analyzer

III. DETAILED REVIEW

The 20 technologies listed in Section II were reviewed initially in Vancouver in October. A detailed review was carried out November 18 to November 22 in Ottawa, using the CANMET files. This review process attempted to answer the following questions for each technology:

1. Is the technology unique, does it do an existing job better or does it have inherent advantages over technology presently being used?
2. Are there any overriding disadvantages to the technology?
3. What is the extent of the possible use of the technology?
4. Is the technology well developed or is more laboratory and/or piloting work required?
5. Is the proposed technology lower in capital or operating cost or does it have a substantial benefit (i.e., recovery) over existing processes? Would the operator have an incentive to change to this technology?
6. What is the degree of intellectual property protection?
7. What industry interest has been generated in the technology?
8. Who are possible licensors of the technology?

These questions were addressed in the reviews that follow in as much detail as time and the data available allowed. The opinions expressed are those of the author for which he takes full responsibility.

PATENT 1

Technology:	Pressure Leaching of Uranium Ores in Chloride Media - Demopoulos/Ritcey
Unique:	Yes
Applicabilities (Market):	All North American uranium ores
Technology Development Level:	Laboratory work only
Patent Position:	Canadian and U. S. patents issued
Advantages/Disadvantages:	1. Radium and rare earths can be recovered, with consequent environmental advantages. 2. Very rapid leach means existing Saskatchewan autoclaves can be used despite low pulp density, if their materials of construction are resistant to chlorine.
Industry Interest:	One request for information only - Urangesellschaft, despite mailings sent to all Canadian companies
Potential Licensors:	Canadian producers
Conclusion:	Do not pursue at present, unless the environmental situation for radium in residues becomes more important. This is because piloting is required, there is no industry interest and the use of existing autoclaves has to be confirmed
Recommendations for Action:	Include in pilot program for Chlorine Metallurgy Pilot Plant only if the use of the existing autoclaves is confirmed. This appears unlikely.
Action by:	X

PATENT 2

Technology:	Percussive Tool with High Pressure Fluid Jet - James/Dorscht
Unique:	Yes
Applicabilities (Market):	Not extensive as water breaking requires more energy than air.
Technology Development Level:	Test program carried out by Teledyne
Patent Position:	U. S. issued, Canadian will be issued soon, Teledyne has assigned their rights to CPDL
Advantages/Disadvantages:	Has higher penetration rate than other systems but energy usage is high.
Industry Interest:	Teledyne did the test work under a DSS contract but have decided not to pursue the technology. Canmet Marketing contacted five companies suggested by Dr. Vijoy of NRC - none was interested.
Potential Licensors:	None
Conclusion:	Do not pursue (as Canmet staff recommended). May consider cancelling Canadian patent application.
Recommendations for Action:	None be taken
Action By:	X

PATENT 3

Technology:	Solid State Arsenic Probe for Use in Pyrometallurgical Processes - Skeaff
Unique:	Yes
Applicabilities (Market):	Very low because arsenic usually associated with SO_2 that is already well controlled
Technology Development Level:	Industrial testing required
Patent Position:	U. S. issued, Canadian applied for.
Advantages/Disadvantages:	
Industry Interest:	Rio Tinto and Matheson Gas Products were contacted directly and showed no interest. Publicity releases were sent out also.
Potential Licensors:	None apparent
Conclusion:	Do not pursue because of the limited application and no industry interest. Consider cancelling Canadian patent application.
Recommendations for Action:	None be taken
Action By:	X

PATENT 4

Technology:	Ferric Chloride Leach of a Metal-Sulphide Bearing Material - Lucas/Shimano
Unique:	Yes
Applicabilities (Market):	All complex lead/zinc/copper ores
Technology Development Level:	Laboratory only, pilot work essential to prove out.
Patent Position:	U. S. issued, Canadian applied for, should consider Australia when Canadian issued.
Advantages/Disadvantages:	Very good recoveries of metal values.
Industry Interest:	This may develop after more data available.
Potential Licensors:	Noragold has exercised its option on exclusive license for New Brunswick and N.W.T. and non-exclusive for the rest of the world.
Conclusion:	This technology is being actively pursued by CANMET in conjunction with the Chlorine Metallurgy Pilot Plant. The marketing strategy should be reviewed now that Novagold has exercised its option.
Recommendations for Action:	Develop marketing strategy.
Action By:	MSL

PATENT 5

Technology:	Copper Recovery from Ammoniacal Solutions using Extraction Mixture - Deschenes/Ritcey
Unique:	Yes
Applicabilities (Market):	Fairly wide
Technology Development Level:	Further testing required
Patent Position:	Canadian issued
Advantages/Disadvantages:	Copper in solution reduced to 1 g/l rather than 100 g/l in processes presently used.
Industry Interest:	Didier had some interest plus several requests, but nothing further.
Potential Licensors:	None at present
Conclusion:	Didier dropped this technology because they felt that it did not have enough of an advantage over established processes. Also patent coverage is limited to Canada. Thus, this should not be pursued.
Recommendations for Action:	None to be taken.
Action By:	X

PATENT 6

Technology:	Method for Analyzing Different Sulphur Forms - Moon
Unique:	Yes
Applicabilities (Market):	Not applicable to Western Canadian coals, but may have use for Eastern U. S. coals. Could be a useful sales tool.
Technology Development Level:	Barringer carried out an extensive test program that showed partial separation between organic and pyritic sulphur, plus some lack of reproducibility from coal to coal. Further testing required.
Patent Position:	U. S., Canadian issued.
Advantages/Disadvantages:	No on-line quick method for differentiating the types of sulphur in coal is available.
Industry Interest:	Leco has shown some interest.
Potential Licensors:	Leco, to go along with their standard equipment.
Conclusion:	A cooperative testing program with Leco would appear to be the best route to follow.
Recommendations for Action:	MSL has contacted Leco who have no interest in further testing. Thus this technology should be dropped.
Action By:	X

PATENT 7

Technology:	Assembly for Concurrent Thermogravimetry and Differential Thermal Analysis - Mikhail
Unique:	Yes
Applicabilities (Market):	Could be useful for coal and coke analysis
Technology Development Level:	Not determined
Patent Position:	U. S., Canadian issued
Advantages/Disadvantages:	Concurrent measurement of TGA and DTA.
Industry Interest:	Only one reply out of 25.
Potential Licensors:	Dupont, as manufacturer of TG equipment.
Conclusion:	Because of little industry interest, the only approach left would be to talk to equipment suppliers such as Dupont.
Recommendations for Action:	Approach Dupont to test and market the unit.
Action By:	MSL

PATENT 8

Technology:	Precious Metals Recovery by Solvent Extraction and Hydrogen Reduction - Demopoulos, et al
Unique:	Yes
Applicabilities (Market):	Not extensive because of few operations involved in separation of precious metals.
Technology Development Level:	Laboratory testing done only. Pilot work required.
Patent Position:	U. S., Canadian issued
Advantages/Disadvantages:	Selective reduction separates the different precious metals, the capital/operating cost advantages of this process over those in use are not known.
Industry Interest:	Many letters of interest.
Potential Licensors:	INRAD of Winnipeg showed interest for six years, their present attitude is unknown.
Conclusion:	The cost advantages/disadvantages of this process need to be determined before any further work is done.
Recommendations for Action:	MSL to determine the present attitude of INRAD. Although the financial advantages of this process over those in use should be determined, cost data on existing processes are not readily available. TEI will contact Johnson-Matthey.
Action By:	MSL/TEI

PATENT APPLICATION 1
(Business Opportunity Document 6)

Technology:	Biodegradation of Alkylene Glycols Utilizing Selected Bacteria - McCready
Unique:	Yes
Applicability (Market):	Limited to airports that require deicing of airplanes
Technology Development Level:	Laboratory only. Pilot work required
Patent Position:	U. S. applied for in 1990, examination taking time
Advantages/Disadvantages:	Cheaper and requires less area than natural degradation panels
Industry Interest:	Airport Commission
Potential Licensors:	Airport Authorities
Conclusion:	This technology appears to have some promise. Because of the complexity of the field, it would be prudent to not do any further marketing until the U. S. patent issues. Canadian patent should be applied for when U. S. situation becomes clearer. Overall marketing strategy needs to be developed as the BOD seems to be a "scatter-gun" approach
Recommendations for Action:	Determine marketing strategy, including cost/benefit analysis and implement when U. S. patent issues. MSL also needs to clarify the jurisdictional questions that have arisen.
Action By:	MSL

PATENT APPLICATION 2

Technology:	Recovery of Gold from Leach Solutions by Pressure Reduction - Deschenes/Ritcey
Unique:	Yes
Applicability (Market):	Wide
Technology Development Level:	Laboratory only, pilot work required.
Patent Position:	U. S., Canadian and Australian applications filed.
Advantages/Disadvantages:	Simple flow sheet and thiourea is non-toxic. Also relatively pure gold can be produced directly. However, the capital and operating costs are similar to conventional processes.
Industry Interest:	Unknown
Potential Licensors:	Unknown
Conclusion:	Although the capital and operating costs are similar to conventional processes, this technology may be worth pursuing because of the apparent non-toxicity of thiourea and the relatively high purity product.
Recommendations for Action:	Determine the long-term toxicity of thiourea.
Action By:	MSL

PATENT APPLICATION 3

Technology:	Long Lasting Thermocouple for High Temperature Measurements of Liquid Metals, Mattes and Slags - Dubreuil/Skeaff
Unique:	Yes
Applicability (Market):	Most pyrometallurgical processes
Technology Development Level:	Tested on metals in laboratory only. Lab tests on mattes and slags required, then field testing.
Patent Position:	U. S., Canadian applications filed.
Advantages/Disadvantages:	Longer life and more accurate than conventional thermocouples. Capital cost needs to be determined.
Industry Interest:	Discussed with Brunswick, Noranda, Inco, Kidd Creek.
Potential Licensors:	Best bet would be thermocouple manufacturers.
Conclusion:	This technology looks promising so the lab testing of different metals, mattes and slags should continue. The marketing strategy should be planned so that it is in place when the patent issues. Broader patent coverage should be considered.
Recommendations for Action:	Continue lab testing and draw up marketing strategy. A cooperative testing program with thermocouple manufacturers should be considered.
Action By:	MSL

PATENT APPLICATION 4

Technology:	Long Lasting Alkali and Alkaline Earth Metal Sensor - Dubreuil
Unique:	Yes
Applicability (Market):	All aluminum foil manufacturing plants
Technology Development Level:	Laboratory testing only. Field testing required
Patent Position:	Canadian and U. S. applications to be filed shortly.
Advantages/Disadvantages:	Quick determination of impurity level in melt has major advantages for foil manufacturers. The economic value of this advantage needs to be determined.
Industry Interest:	Informal talks with Reynolds.
Potential Licensors:	Best would be laboratory equipment manufacturers.
Conclusion:	This technology looks very promising but no contact should be made with potential users or equipment vendors until the applications have been filed. A cooperative test program with an equipment manufacturer should be considered.
Recommendations for Action:	Formulate marketing strategy closer to time P. A.'s will be filed.
Action By	MSL

PATENT APPLICATION 5

Technology:	Filtration of Fine Solids Using Hot Steam or Gas and Filter-aid Vapour - Stefanski
Unique:	Yes
Applicability (Market):	All mineral/residue filtering processes
Technology Development Level:	Laboratory work only
Patent Position:	U. S. application filed, Canadian under way.
Advantages/Disadvantages:	Lower moisture in filter cake.
Industry Interest:	Unknown
Potential Licensors:	Filter manufacturers.
Conclusion:	This technology is in its infancy but it may have great possibilities. After the patent application has been filed, a laboratory and pilot test program should be developed. This is a natural for a cooperative test program with a filter manufacturer.
Recommendations for Action:	Formulate marketing strategy and pursue a cooperative testing program.
Action By:	MSL

PATENT APPLICATION 6

Technology:	Hydrometallurgical Silver Refining - Tan/Dinardo
Uniqus:	Yes
Applicability (Market):	Limited to producers of silver from a high arsenic and antimony dore' metal.
Technology Development Level:	Laboratory testing done in cooperation with Maple Leaf Smelting and Processing Company.
Patent Position:	Canadian application filed in 1990, U. S. filed in 1991.
Advantages/Disadvantages:	Process may be simpler than that presently and by MLSP. It may have environmental advantages.
Industry Interest:	?
Potential Licensors:	MLSP
Conclusion:	The laboratory program is inactive at present. The present status of MLSP's interest should be determined. Cancelling the P.A. should be considered.
Recommendations for Action:	None to be taken other than talking to MLSP.
Action By:	X

PATENT APPLICATION 7
(Business Opportunity Docment 4)

Technology:	Microwave Regeneration of Activated Carbon
Unique:	Yes
Applicability (Market):	All gold producers using carbon absorption, water purification plants.
Technology Development Level:	
Patent Position:	Canadian application filed, U. S. application abandoned.
Advantages/Disadvantages:	Minor operating cost advantage over present activated carbon regenerators, but capital cost saving appear to be major.
Industry Interest:	Unknown
Potential Licensors:	Suppliers of microwave equipment, suppliers of thermal regenerators
Conclusion:	This technology is attractive and the capital cost advantages appear to be important.
Recommendations for Action:	The capital cost advantages should be confirmed and then a marketing strategy developed.
Action By:	MSL

PATENT APPLICATION 8

Technology:	Bioabsorption Composition: Process for Production and Process for Use - McCready, et al
Unique:	Yes
Applicability (Market):	May be fairly extensive beyond uranium in mine water.
Technology Development Level:	Small lab tests done only, needs broader test program to extend its usefulness, then field trials.
Patent Position:	U. S. Canadian applications filed in 1989. Canadian patent should issue shortly.
Advantages/Disadvantages:	Has potential but needs to be investigated further.
Industry Interest:	Unknown
Potential Licensors:	Could be uranium producers, but more properly could be marketed by an environmental engineering firm.
Conclusion:	This technology could have major applications, but much more exploratory laboratory work needs to be done to determine the extent of its usefulness and its advantages. Piloting and field testing would then be required.
Recommendations for Action:	Do further laboratory testing on other heavy metals.
Action By:	MSL

PATENT APPLICATION 9

Technology:	Reynolds Bubble Measurement Cell - Reynolds
Unique:	Yes
Applicability (Market):	Could be used by research laboratories to design more efficient bubble generators.
Technology Development Level:	Completed
Patent Position:	U. S., Canadian applications filed 1990.
Advantages/Disadvantages:	Unique as there is no other method of determining bubble size.
Industry Interest:	Eight mining companies funded the work with which this development was associated. Do they have a share in the technology?
Potential Licensors:	Brinkman could market this as an attachment for their particle size apparatus.
Conclusion:	No further laboratory or pilot work is required. As this could be a valuable tool for sparger manufacturers, the next steps should be to determine the market size and to sound out Brinkman as to their interest in selling this unit.
Recommendations for Action:	1. Determine market size. 2. Approach Brinkman.
Action By:	TEI

PATENT APPLICATION 10

Technology:	Recovery of Gold from Thiourea, Thiocyanate or Thiosulphate Solutions by Reduction-Precipitation with a Stabilized Form of Sodium Borohydride - Awadalla/Ritcey
Unique:	Yes
Applicability (Market):	Most gold producers
Technology Development Level:	Extensive laboratory work done, pilot testing will be required.
Patent Position:	Canadian, U. S. applications filed simultaneously with that of Haque (Different process to achieve same result).
Advantages/Disadvantages:	Appears to be a fast, simple process with several advantages over present practice. However, most producers do not use a "thio-based" leach.
Industry Interest:	Unknown
Potential Licensors:	
Conclusion:	Patent is to be issued shortly, but the cost advantage for existing producers is not great enough to have them changed unless thiourea proves to have long term benefits.
Recommendations for Action:	The long term toxicity of thiourea-type leaching needs to be determined.
Action By:	MSL - long term

PATENT APPLICATION 11

Technology:	Recovering of Platinum Group Metals from Acidic Solutions by Reduction-Precipitation with Sodium Borohydride - Awdalla/Molnar/Ritcey
Unique:	Yes
Applicability (Market):	PGM producers only
Technology Development Level:	Extensive laboratory testing done
Patent Position:	U. S., Canadian applications filed
Advantages/Disadvantages:	Simpler and faster process than those presently used. Also solution is recyclable.
Industry Interest:	Unknown
Potential Licensors:	PGM producers
Conclusion:	This process seems to have advantages for PGM producers. However, cost data are not available.
Recommendations for Action:	TEI will approach Johnson Matthey.
Action By:	TEI

PATENT APPLICATION 12

Technology:	Use of Microwave Radiation to Eliminate Foam in Ore Leaching - Kondos
Unique:	Yes
Applicability (Market):	Very narrow in U. S. as limited to BeO leaching
Technology Development Level:	Laboratory work done
Patent Position:	U. S. application filed and allowed only with claims limited to BeO/H2 SO4 - patent will issue shortly. Canadian application filed October, 1991.
Advantages/Disadvantages:	Reduces foaming during leaching so could be very useful.
Industry Interest:	Unknown, but should be considerable.
Potential Licensors:	Mineral equipment manufacturers could be interested.
Conclusion:	Because the patent claims have been restricted in the U. S., the possibility of any major royalty is remote. However, mineral equipment manufacturers might be interested in the application of this know-how to other leaching processes.
Recommendations for Action:	Approach manufacturers for expression or interest.
Action By:	MSL

BUSINESS OPPORTUNITY DOCUMENT 1

Technology:	Supplementary Cementing Materials
	A great deal of work has gone into developing a number of interesting applications for substituting waste materials for cement. However, based on the information available, it would appear that the financial return to CANMET has not been maximized. Thus, it is suggested that a comprehensive marketing strategy be developed with emphasis on the return to CANMET.
Action:	1. Review net back to CANMET. 2. Develop marketing strategy maximizing return.
Action By:	MSL

BUSINESS OPPORTUNITY DOCUMENT 2

Technology:	Biological Recovery of Selenium
	This interesting and unique process would appear to have a fairly large potential. An overall strategy for development of the technology needs to be formulated. This would involve review of the producers of selenium, processes presently being used to remove selenium, etc. At the same time, a rough capital and operating cost comparison with the existing processes needs to be done, then CANMET can seek a partner or partners with confidence.
Action:	Develop capital/operating cost comparisons and approach Canadian producer.
Action By:	MSL

BUSINESS OPPORTUNITY DOCUMENT 3

Technology:	Hyceram
	This technology appears to have a number of possible uses. Two applications have been developed already. The next step in furthering this technology would seem to be to identify potential licensors in the various fields that could use the technology, then these potential licensors should be approach by CANMET personally, keeping in mind always the maximization of the return to CANMET.
Action:	Identify potential licensors and develop marketing strategy.
Action By:	MSL

BUSINESS OPPORTUNITY DOCUMENT 4

Technology:	Microwave Regeneration of Activated Charcoal
	As noted in the Review of Patent Application 7, the key to exploitation of this technology is the capital and operating cost savings that have been identified.
Action:	Confirm capital/operating cost savings and then develop marketing strategy.
Action By:	MSL

BUSINESS OPPORTUNITY DOCUMENT 5

Technology:	Productive Use of Zinc Residues
	The BOD does not explain the process proposed as fully as might be desired by potential users. Thus, a review of the overall strategy to be pursued needs to be carried out so that the best approach can be identified. This review ideally should include personnel from the zinc industry itself.
Action:	Review of overall strategy.
Action By:	TEI

BUSINESS OPPORTUNITY DOCUMENT 6

Technology: Biodegradation of Toxic Substances in Airport Runoff

(See Patent Application 1)

BUSINESS OPPORTUNITY DOCUMENT 7

Technology:	Image Analysis System The economics of this system need to be reviewed in detail because the technology seems to have a great deal of potential for almost all milling and beficiation operations in the world. Depending on the results of this economic review, CANMET should then develop a strategy for introducing this service to the mining industry.
Action:	Review economics, develop business plan to service the industry and formulate marketing strategy.
Action By:	MSL/TEI

BUSINESS OPPORTUNITY DOCUMENT 8

Technology:	Froth Analyzer
	This technology appears to have a major application in flotation circuits worldwide. The discussions presently under way with equipment suppliers such as Outokumpu appears to be the best way to market this technology.
Action:	Continue discussions with Outokumpu.
Action By:	MSL

IV. CONCLUSIONS AND RECOMMENDATIONS

A. Patents:

1. Pressure Leaching of Uranium Ores in Chloride Media

This technology should not be pursued unless the environmental situation for radium in residues becomes more critical. This conclusion has been reached because piloting will be required, there has been no industry interest despite mailings to Canadian companies and the use of the existing autoclaves in Saskatchewan will have to be confirmed.

It is recommended that the chlorine resistance of the Saskatchewan autoclaves be determined and if acceptable, this work be included in the program for the Chlorine Metallurgy Pilot Plant.

2. Percussive Tool with High Pressure Fluid Jet

Although some improvement in penetration rate was obtained, the unit energy consumption is much higher than using air. Further there has been no interest shown by any of the companies contacted. It is recommended that this technology be dropped and that the Canadian patent application be cancelled.

3. Solid State Arsenic Probe

The applicability of this technology is extremely limited and there has been no industry interest. Thus this technology should be dropped along with the Canadian patent application.

4. Ferric Chloride Leach of a Metal-Sulphide Bearing Material

This technology has quite wide application and should be included in the CANMET Chlorine Metallurgy Pilot Program. The overall marketing strategy should be reviewed, as NOVAGOLD has exercised its option.

5. Copper Recovery for Ammoniacal Solutions

This process does not appear to have any major advantage over the processes presently being used. As there is no industry interest, this technology should be dropped.

6. Method for Analyzing Different Sulphur Forms

This technology is not sufficiently well developed to permit marketing. As LECO is not interested in a cooperative testing program, the technology should be dropped.

7. Assembly for Concurrent Thermogravimetry and Differential Thermal Analysis

Because there is little industry interest, the best approach is to determine the interest of equipment suppliers such as Dupont. If they are not interested, then the technology should be dropped.

8. Precious Metal Recovery by Solvent Extraction and Hydrogen Reduction

Although there has been considerable interest from industry, the cost advantages of the process need to be determined before any further laboratory or piloting work is done. Because there is little cost data available from the existing PM producers, TEI will approach Johnson Matthey to see if some can be provided. Also the present position of INRAD vis-a-vis licensing the process should be investigated.

B. Patent Applications:

1. Biodegradation of Alkylene Glycols

This technology appears to have some promise, although it is limited to those airports that require airplane de-icing. Because of the complexity of the field, further marketing should not be done until the U. S. patent is issued. Also the Canadian patent application should only be filed when the U. S. situation is clarified. It will be necessary to develop an overall marketing strategy, including cost/benefit analysis. An additional problem to be resolved is the federal jurisdictional responsibility.

2. Recovery of Gold from Leach Solutions by Hydrogen Reduction

Although the capital and operating costs are similar to conventional processes, this technology is simpler and less toxic than the conventional route. The long-term toxicity of thiourea should be determined.

3. Long Lasting Thermocouples

This technology looks promising and has a broad application. Thus, the laboratory testing of different metals, mattes and slags should continue, presumably as a cooperative program with a thermocouple manufacturer. Also the marketing strategy should be developed so that it is in place when the patents issue. Coverage beyond Canada and the U. S. should be considered.

4. Long Lasting Alkali Sensor

   Because of its uniqueness, this technology looks very promising. However, as a protective measure, no contact should be made with potential users or equipment vendors until the patent applications have been filed. A marketing strategy should be formulated closer to the time the patent applications are filed. This strategy should consider a cooperative test program with an equipment manufacturer.

5. Filtration of Fine Solids Using Hot Steam or Gas and Filter-aid Vapour

   This technology is in its infancy and it may have great possibilities. After the Canadian patent application is filed, a laboratory and pilot test program should be developed. This technology is a natural for a cooperative test program with a filter or similar manufacturer. A marketing strategy should be formulated before the test program is pursued.

6. Hydrometallurgical Silver Refining

   The laboratory program is inactive at present. The present status of Maple Leaf Smelting and Processing Company should be determined. If they do not have a further interest, the technology should be dropped and the patent applications abandoned.

7. Microwave Regeneration of Activated Carbon

   This technology is attractive and the preliminary capital cost calculations appear promising. These cost advantages should be confirmed and a marketing strategy developed.

8. Bioabsorption Composition

   The technology would have major applications, but much more exploratory laboratory work needs to be done to determine the extent of its usefulness and its advantages. Piloting and field testing would then be required.

9. Reynolds Bubble Measurement Cell

   No further laboratory on pilot work is required. As this could be a valuable tool for sparger manufacturers, the next steps should be to determine the market size and to sound out Brinkman as to their interest in selling this unit.

10. Recovery of Gold from Thiourea Type Solutions by Sodium Borohydride Reduction - Precipitation

    The U.S. patent will be issued shortly, but the cost advantage of the process is not great enough to have existing producers change. This may be revised if thiourea is found to have long-term benefits over cyanide leaching. Thus the long-term toxicity of thiourea-type leaching needs to be determined.

11. Recovery of PGM using Sodium Borohydride Precipitation

    This process seems to have advantages for PGM producers. However, data from existing producers will be sought to confirm this.

12. Use of Microwave Radiation to Eliminate Foam in Ore Leaching

    Because the patent claims have been restricted to beryllium oxide leaching in the U. S., the possibility of major royalty revenue is remote. However, a mineral equipment manufacturer might be interested in the application of this know-how to other leaching processes.

C. Business Opportunity Documents

1. Supplementary Cementing Materials

   A comprehensive marketing strategy should be developed with emphasis on the return to CANMET.

2. Biological Recovery of Selenium

   This interesting and unique process seems to have a fairly large potential. However, a rough capital/operating cost comparison with the existing processes needs to be done as a first step in formulating an overall marketing strategy. The identification of a Canadian producer is highly desirable.

3. Hyceram

   This promising technology has a number of possible uses, two of which have already been developed. The next step should be to identify possible licensors in the various fields that could use this technology. Then these licensors should be approached, keeping in mind maximization of return to CANMET.

4. Microwave Regeneration of Activated Charcoal

   As noted in P. A. No. 7, the key to exploitation of this technology in the confirmation of the capital cost savings that have been identified.

5. Productive Use of Zinc Residues

   Because of the potential that this process has, an in depth review of the strategy to further the test program required should be carried out.

6. Biodegradation of Toxic Substances in Airport Runoff

   As noted in P. A. No. 1, further work on developing an overall marketing strategy and cost/benefit analysis should be done when the U. S. patent is issued. Also jurisdictional questions should be resolved.

7. Image Analysis System

   The economics of this system need to be reviewed in detail because this technology seems to have a great deal of potential for almost all milling and beneficiation operations in the world. A business plan, including the overall marketing strategy, needs to be developed.

8. Froth Analyzer

   This technology appears to have a major application in flotation circuits worldwide. The present discussions with Outokumpu on developing and marketing this technology should be actively pursued.

V ACTION PLAN

A. Patents

1. Pressure Leaching of Uranium Ores in Chloride Media

   Action: Check chloride resistance of Saskatchewan autoclaves

   By: MSL

2. Percussive Tool with High Pressure Fluid Jet

   Action: None

   By: X

3. Solid State Arsenic Probe

   Action: None

   By: X

4. Ferric Chloride Leach of Metal-Sulphide Bearing Material

   Action:
   - Include in chlorine metallurgy pilot program
   - Develop marketing strategy

   By: MSL

5. Copper Recovery from Ammoniacal Solutions

   Action: None

   By: X

6. Method of Analyzing Different Sulphur Forms

   Action: Contact Leco for cooperative development program (done)

   By: MSL

7. Assembly for Concurrent TGA/DTA

   Action: Contact Dupont on their interest

   By: MSL

8. Precious Metal Recovery by Solvent Extraction and Hydrogen Reduction

   Action:
   - Determine INRAD's position
   - Approach Johnson-Matthey for access to capital/operating costs

   By: MSL/TEI

B. Patent Applications

1. Biodegradation of Alkylene Glycols

   Action:
   - Do cost/benefit analysis
   - Determine marketing strategy
   - Resolve jurisdictional problems

   By: MSL

2. Recovery of Gold by Hydrogen Reduction

   Action:
   - Determine long-term toxicity of thiourea.

   By: MSL

3. Long Lasting Thermocouples

   Action: Extend field of use, preferably with cooperative program with thermocouple manufacturer

   By: MSL

4. Long Lasting Alkali Sensor

Action:
- Develop marketing strategy
- Develop cooperative test program with analytical equipment manufacturer when patent application filed.

By: MSL

5. Filtration of Fine Solids using Hot Steam or Gas and Filter-aid Vapour

Action:
- Develop marketing strategy
- Establish cooperative test program with filter manufacturer

By: MSL

6. Hydrometallurgical Silver Refining

Action: Cancel Patent Application

By: MSL

7. Microwave Regeneration of Activated Carbon

Action:
- Confirm capital and operating cost advantages
- Determine marketing strategy

By: MSL

8. Bioabsorption Composition

Action: Continue laboratory testing to extend its usefulness, then review marketing strategy

By: MSL

9. Reynolds Bubble Measurement Cell

Action: - Determine market potential

- Approach Brinkman

By: TEI

10. Recovery of Gold using Sodium Borohydride

Action: None

By: X

11. Recovery of Platinum Group Metals using Sodium Borohydride

Action: - If cost data from PGM producers are available, cost comparisons should be made

By: MSL

12. Microwave Radiation to Eliminate Foam in Ore Leaching

Action: Approach mineral equipment manufacturer to develop cooperative testing program

By: MSL

C. Business Opportunity Documents

1. Supplemental Cementing Materials

Action: Develop comprehensive marketing strategy to maximize return

By: MSL

2. Biorecovery of Selenium

Action: Do capital/operating cost comparisons and seek Canadian partner

By: MSL

3. Hyceram

Action: Develop overall marketing strategy including evaluation of best areas to concentrate efforts

By: MSL

4. Microwave Regeneration of Carbon

Action: Confirm capital cost advantages and develop marketing strategy

By: MSL

5. Productive Use of Zinc Residues

Action: Develop over all strategy and identify possible domestic partner

By: TEI

6. Biodegradation of Airport Runoff

Action: As noted in P.A.No.1, do cost/benefit analysis, determine marketing strategy and resolve jurisdictional problem.

By: MSL

7. Image Analysis System

Action: Review economics, develop business plan and formulate marketing strategy

By: TEI/MSL

8. Froth Analyzer

Action: Develop relationship with partner (Outokumpu)

By: MSL